Pb–Sn eutectic and low content Al alloys. However, there are three reservations. Firstly, a discharge coefficient must sometimes be included in Liebermann and Graham's analysis of ribbon cross-sectional area, to allow for inefficient ejection at the orifice. Secondly, there is considerable scatter in the variation of ribbon thickness, although the average trend is still in quite good agreement with Kavesh's analysis. Thirdly, the liquid viscosity in Liebermann's empirical relation for ribbon width is considerably lower in a crystallizing alloy compared to the amorphous alloys studied previously.

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The strength of α-sialon ceramics

A new member of sialon ceramics, which has the α-Si_3N_4 structure, has been considered in recent publications [1–3]. The general formula for α-sialon, $M_n(Si, Al)_{12}(O, N)_{16}$ where $M = Li$, Mg, Ca, or Y and $n \leqslant 2$, shows that the M ion dissolves at interstitial sites. There are two interstitial sites for the dissolution in a unit cell of α-sialon [1].

The reaction for α-sialon formation is shown by Y-α-sialon with, for example,

$$Si_3N_4 + a(Y_2O_3 + 9AlN) \rightarrow$$
$$Y_{2a}(Si_3, Al_{9a})(O_{3a}, N_{4+9a}),$$

where $a \leqslant 1$. The end member for the reaction, $(Y_2O_3 + 9AlN)$, corresponds to $Y_2(Al_9)(O_3, N_9)$ although the compound was not formed by the reaction of Y_2O_3 and AlN. The equation shows that the metal to non-metal ratio (M/X) is kept constant (3/4) in the network of α-sialon. There is no vacant site in the network of α-sialon formed by the (Si, Al)(O, N)$_4$ tetrahedron as in β-sialon $(Si_{6-z}Al_zO_zN_{8-z},\ 0 < z \leqslant 4.2)$, But when interstitial sites are partly occupied by metal ions, the rest can be regarded as vacant sites which may allow ionic conduction [4]. The other characteristic of α-sialon is a low oxygen content compared with that in β-sialon [1]. α-sialon ceramics have potential for application as electrical or mechanical materials at high temperatures, but as far as we know, there have been no reports on the properties of α-sialon. The present communication reports on the strength of hot-pressed (HP) and reaction-sintered (RS) Y-α-sialon. The composition used in the present work was $Y_{0.41}(Si_{10.2}Al_{1.8})(O_{0.6}, N_{15.4})$.

Hot-pressed α-sialon was obtained by heating the powder mixture (Si_3N_4* 50, Y_2O_3† 3, and

TABLE I The Composition of α-sialon

	Y	Si	Al	O	N
Calc	0.41	10.2	1.8	0.6	15.4
Obs	0.45	9.5	2.5	1.0	14.9

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†Shin-etsu Chemical, Japan.

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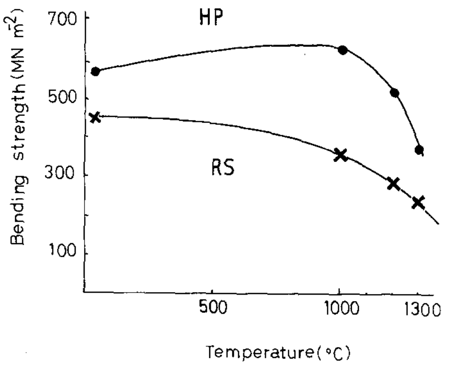

Figure 1 Variation of the banding strength of Hot-pressed (HP) and reaction-sintered (RS) α-sialon with temperature.

AlN* |27, in molar ratio) at 1750° C for 1 h under a pressure of 200 kg cm^{-2} (20 MN m^{-2}) in a graphite die of 50 mm diameter. The sintered materials were cut in to rectangular shapes of about 3.5mm x 3.5 mm x 32 to 50 mm in size and then polished with a 600-grit diamond wheel. The density of the materials was about 3.25 g cm^{-3}; the theoretical value was also 3.25 g cm^{-3} [1].

The α-sialon ceramics were also fabricated by heating the rectangular shaped powder mixture at 1750° C for 1 h in a nitrogen atmosphere. The density of reaction-sintered or pressureless-sintered α-sialon was 3.18 g cm^{-3} (97.8% theoretical).

Analysis of the composition was performed by EPMA. The results are shown in Table I. Fairly good agreement with the calculated value is shown.

The strength of hot-pressed and reaction-sintered sialon was measured with spans of 30 and 20 mm, respectively, by a three-point bending test up to 1300° C. The results are shown in Fig. 1: this shows that the strength of hot-pressed sialon was 550 to 650 MN m^{-2} up to 1000° C and degraded at higher temperatures. The strength of reaction-sintered sialon was 450 MN m^{-2} at room temperature and decreased at high temperatures.

The thermal shock resistance of hot-pressed α-sialon was measured and compared with that of hot-pressed β-sialon as shown in Fig. 2. The data were obtained by measuring the three-point bending strength of materials after quenching them into water from high temperatures. The value of ΔT for α-sialon was about 480° C, whereas that for β-sialon was about 430° C.

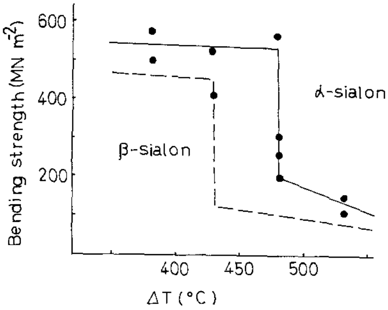

Figure 2 Strength of sialons after thermal shock treatment.

The microstructure of fractured surfaces revealed that the fracture propagated intergranularly even at room temperature. The strength degradation at high temperature might be due to the presence of a glassy phase at grain boundaries. This suggests that the strength of α-sialon at high temperature may be improved by decreasing the glassy phase.

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